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PI - Signature   Date

ACTIGRAPHY PROJECT
WALTER REED ARMY INSTITUTE OF RESEARCH

Submitted by

Biomedical Engineering Center
Purdue School of Engineering and Technology, IUPUI

Introduction

During the third quarter of activity, Purdue School of Engineering and Technology representatives continued to process data files received from WRAIR, participated in two project meetings, one at WRAIR in Washington, DC, and one in Indianapolis, and worked with WRAIR representatives to refine the project objective. The system design deliverable was completed and is included with this report. Some support activities for WRAIR's upcoming "Rosetta Stone" study were also carried out. Following are summaries of each of these activities. Working on the project during this time period were Prof. Russ Eberhart, Principal Investigator, and Mr. Xiaohui Hu, Research Assistant.

Project Meetings

Project meetings were held at WRAIR in March 1999 and in Indianapolis in April 1999. Methods of data analysis were discussed. At the meeting in April, it was decided to further refine the work done in phase I to include a software tool to predict PVT performance (reaction times) based on polysomnography data (sleep scoring). The system design information presented at the April meeting was deemed sufficient to meet the deliverable requirement, for which an extension until May 14, 1999 has been requested.

System Design Deliverable

The primary goal of Phase I of this contract is to develop a software analysis tool that classifies a subject as asleep or awake from actigraph data. Neural network tools that achieve a testing accuracy of 93-95 percent have been developed using particle swarm optimization. Included with this quarterly report is a diskette with the trained neural network weights that achieved these results (files r201.wts and r202.wts) and the particle swarm based neural network executable code (file psonn99.exe). Also included is the Visual Basic demonstration code for particle swarm optimization (file swarm98a.zip). The demonstration code can be used to optimize several benchmark functions, which are included.

Attached as Appendix A is a printout of training and test results that includes results for the two above-mentioned weight files. It can be seen that the performance on test data (not used for training) was about 95.6% correct for r201.wts and 93.2% for r202.wts. Attached as Appendix B is a listing of the Visual Basic source code for the particle swarm demonstration.

Data Preprocessing

As of May 6, 1999, we have received 65 actigraph data sets on CD. A listing of these data sets is attached as Appendix C. Also listed in Appendix C are the four sleep data files we have received.

Each sleep data file starts with the sleep period of day 3 at 23:00. Seven days of sleep of a specified length (3, 5, 7, or 9 hours) follows, followed by three days of recovery (9 hours per night).

During the April project meeting, the preprocessing of the actigraph and sleep files was reviewed in detail. A flowchart describing the preprocessing is attached as Appendix D. During the discussion of the flowchart, it was pointed out that actigraph data values are for the *previous* four seconds, where sleep scores are for the *next* 30 seconds (or 16 seconds during SLT). It was decided to shift all actigraph data 4 seconds "to the left" (earlier) so that it is consistent with the sleep scores.

One item was not resolved. When we process the data into 60-second blocks, there are occurrences of "1 0" or "0 1" (sleep wake or wake sleep). We need to know whether to score these one-minute periods as sleep or wake. WRAIR is supposed to get an answer to us very soon.

Data Analysis

During the April project meeting, it was decided that we would focus on prediction of PVT data using the sleep-wake scoring and the WRAIR performance model. We will use particle swarm optimization to evolve the performance model parameters.

WRAIR will provide the performance model as soon as a confidentiality agreement in the form of a CRADA is executed. IUPUI signed the CRADA on or about April 20, 1999, and forwarded it to WRAIR. We have not received the executed CRADA as of May 6, 1999. Receipt of the WRAIR performance model is necessary for us to proceed.

TeleActigraph-Related Activities

Activities related to Precision Control Design's TeleActigraph (TAG) system were carried out during the quarter that were designed to support WRAIR's upcoming "Rosetta Stone" study. These activities, which were coordinated with Precision Control Design staff, included:

1) Writing and compiling a program to pre-process raw data as downloaded from the belt unit into an ASCII data file with one line per reading. This program was provided to WRAIR in February 1999.
2) Writing and revising a Matlab script to load a data file and display various attributes including power spectral density, and normalized amplitude versus frequency. This script was provided to WRAIR in February 1999.
3) Acquiring resting (awake) data from five additional "normal" subjects, from which amplitude and frequency characteristics of typical wrist tremor (with unsupported elbow) can be derived. We now have data on 12 normal subjects. This data will be useful for the Rosetta Stone study.
4) Becoming more familiar with TAG System operation so as to provide observations and guidance to WRAIR on system operation during the Rosetta Stone study. Observations and guidance (in addition to that in that last Quarterly Report) include:
   a) Real-time data acquisition (instead of off-line downloading of data) still seems to be a very good way to acquire data from the belt unit, at least during sleep periods. We have ordered a 12-bit National digital-to-analog PCMCIA card for use in a laptop computer that is running LabView for Windows. A LabView script has been written that permits monitoring of data as it is acquired and stored, which has several obvious advantages.
   b) We have installed a vibration testing system featuring a VTS600 600-watt amplifier and a Model VG 100 vibrator (Vibration Test Systems, Aurora, Ohio). It should be noted that this system was received "on loan" from Dr. David Burr at the Indiana University Medical School at no cost to this project. We use a Techtronics waveform generator or a pulse generator to drive the system, and monitor results with a digital scope and a PC with Labview installed.

TAG units have been preliminarily characterized and calibrated, and benchmarked against the BMA-32 actigraph units that will be used concurrently in the Rosetta Stone study. Results of this work were provided to WRAIR and PCD staff members at the April project meeting. It appears that one count from the TAG unit in Mode 9 corresponds to an acceleration of about 2 milli-gravities. Further work will be documented in the next quarterly report.

c) Some concern exists with respect to the fidelity of data being received from the TAG units. Driving them with sine waves with less than one percent harmonic distortion results in output data that is not as nearly a sine wave as might be desired. Output data examples obtained when driving the TAG with a 6mm peak-peak sine wave at 1, 2, and 3 Hz are attached as Appendix E. This matter is being investigated with the full cooperation of PCD. We are also examining our test configuration. Nothing is being ruled out at this time.

APPENDIX A

Date: 1999-03-10 14:09:58
Neural Net topology: 7 inputs, 14 Hiddens, 2 outputs
Training is stoped: 14000 iterations or 0.025000 errors
TrainSet: 157200.tr
TestSet : 157200.te

	class00	class01	total
Weights :	r200.WTS		
TrainSet:	0.875519 (211/ 241)	0.911950 (145/ 159)	0.890000 (356/ 400)
Rules :	0.879668 (212/ 241)	0.937107 (149/ 159)	0.902500 (361/ 400)
TestSet :	0.895323 (402/ 449)	0.769231 (60/ 78)	0.876660 (462/ 527)
Rules :	0.917595 (412/ 449)	0.794872 (62/ 78)	0.899431 (474/ 527)
Weights :	r201.WTS		
TrainSet:	0.937759 (226/ 241)	0.918239 (146/ 159)	0.930000 (372/ 400)
Rules :	0.921162 (222/ 241)	0.930818 (148/ 159)	0.925000 (370/ 400)
TestSet :	0.959911 (431/ 449)	0.820513 (64/ 78)	0.939279 (495/ 527)
Rules :	0.977728 (439/ 449)	0.833333 (65/ 78)	0.956357 (504/ 527)
Weights :	r202.WTS		
TrainSet:	0.904564 (218/ 241)	0.962264 (153/ 159)	0.927500 (371/ 400)
Rules :	0.908714 (219/ 241)	0.981132 (156/ 159)	0.937500 (375/ 400)
TestSet :	0.917595 (412/ 449)	0.884615 (69/ 78)	0.912713 (481/ 527)
Rules :	0.937639 (421/ 449)	0.897436 (70/ 78)	0.931689 (491/ 527)

Date: 1999-03-10 14:09:55
Neural Net topology: 7 inputs, 14 Hiddens, 2 outputs
Training is stoped: 16000 iterations or 0.025000 errors
TrainSet: 157200.tr
TestSet : 157200.te

	class00	class01	total
Weights :	r21a0.WTS		
TrainSet:	0.937759 (226/ 241)	0.886792 (141/ 159)	0.917500 (367/ 400)
Rules :	0.950207 (229/ 241)	0.918239 (146/ 159)	0.937500 (375/ 400)
TestSet :	0.955457 (429/ 449)	0.717949 (56/ 78)	0.920304 (485/ 527)
Rules :	0.979955 (440/ 449)	0.743590 (58/ 78)	0.944972 (498/ 527)
Weights :	r21a1.WTS		
TrainSet:	0.941909 (227/ 241)	0.886792 (141/ 159)	0.920000 (368/ 400)
Rules :	0.921162 (222/ 241)	0.899371 (143/ 159)	0.912500 (365/ 400)
TestSet :	0.937639 (421/ 449)	0.730769 (57/ 78)	0.907021 (478/ 527)
Rules :	0.962138 (432/ 449)	0.769231 (60/ 78)	0.933586 (492/ 527)

APPENDIX B

```
' Particle swarm VB5 software by Russ Eberhart
' Make sure that the Open statement on line 40 points to the correct directory
' May 18, 1998, graph iGbest, iLbest
' May 29, 1998, added f0, f1, f2, f3, f5
Option Explicit
Option Base 1
  Dim iPOPSIZE As Integer           ' Population size
  Dim iDIMENSIONS As Integer        ' Number of dimensions
  Dim iPopindex As Integer          ' Index for population
  Dim iDimindex As Integer          ' Index for dimensions
  Dim fINITWT As Single             ' Initial inertia weight
  Dim fMAXVEL As Single             ' Maximum velocity allowed
  Dim nMAXITER As Integer           ' Maximum number of iterations
  Dim nIter As Integer              ' Number of iterations
  Dim fPos() As Single              ' Position for each particle
  Dim fTempPos() As Single          ' Temporary updated position for each particle
  Dim fVel() As Single              ' Velocity for each particle
  Dim fDumVel() As Single           ' Dummy velocity vector 1-dim array
  Dim fBestPos() As Single          ' Best previous position for each particle
  Dim fMaxPos As Single             ' Dynamic range
  Dim fInerWt As Single             ' Inertia weight
  Dim fErrVal() As Double           ' Function error value calculated by eval()
  Dim fPbestVal() As Double         ' Best error value over time for each particle
  Dim fERRCUTOFF As Double          ' Error value at which system stops
  Dim iUSEBETTER As Integer         ' Usebetter is kind of a momentum
  Dim iBetter() As Integer          ' This gets set in program
  Dim iGbest As Integer             ' Index for global best particle
  Dim iLbest As Integer             ' Index for local (neighborhood) best particle
  Dim iLOCAL As Integer             ' Neighborhood size specified in run file
  Dim iHOODSIZE As Integer          ' Neighborhood size used in program
  Dim iHOODINDEX As Integer         ' Neighborhood index (offset from particle)
  Dim iNeighbor() As Integer        ' Popindexes of neighbors resulting from iLOCAL
  Dim sOutfile As String            ' Filename for output
  Dim iXcoord As Integer, iYcoord As Integer     ' x & y coords for plots
  Dim iFNCTNO As Integer            ' Function number to be optimized (1=f1, etc.)
  Dim fErrValDim As Double          ' Error value for a single dimension
  Const conPI = 3.14159265358979       ' Define Pi

Private Sub cmdSwarm_Click()

  Open "c:\mydocs\vb\psoinput.txt" For Input As #1
    Input #1, iPOPSIZE, iFNCTNO, iDIMENSIONS, fERRCUTOFF, fMAXVEL, fMaxPos, _
      nMAXITER, iUSEBETTER, fINITWT, iLOCAL, sOutfile
     ' Population size, function no. to be optimized, no. of dimensions,
     ' error cutoff value, maximum velocity, maximum position
     ' (range), maximum no. of iterations, use momentum (usebetter), initial
     ' inertia weight, neighborhood (0=global, even no. for local neighborhood),
     ' filename for output
  Close #1

  If iFNCTNO = 6 Or iFNCTNO = 5 Then iDIMENSIONS = 2  'Set # of dimensions for f5 & f6 fnctns

  ReDim fPos(iPOPSIZE, iDIMENSIONS)
  ReDim fTempPos(iPOPSIZE, iDIMENSIONS)
  ReDim fVel(iPOPSIZE, iDIMENSIONS)
  ReDim fBestPos(iPOPSIZE, iDIMENSIONS)
  ReDim fDumVel(iDIMENSIONS)
  ReDim fErrVal(iPOPSIZE)
  ReDim fPbestVal(iPOPSIZE)
  ReDim iBetter(iPOPSIZE)
  ReDim iNeighbor(-iPOPSIZE To iPOPSIZE)

    picSwarm1.BackColor = vbBlack

    If iLOCAL > 0 Then iHOODSIZE = Int(iLOCAL / 2#) * 2# Else iHOODSIZE = iPOPSIZE

    Randomize
    ' Randomize the positions and velocities for entire population
```

```
For iPopindex = 1 To iPOPSIZE
    For iDimindex = 1 To iDIMENSIONS
        fPos(iPopindex, iDimindex) = Rnd * fMaxPos
        fBestPos(iPopindex, iDimindex) = fPos(iPopindex, iDimindex)
        fVel(iPopindex, iDimindex) = Rnd * fMAXVEL
        If Rnd > 0.5 Then fPos(iPopindex, iDimindex) = -fPos(iPopindex, iDimindex)
        If Rnd > 0.5 Then fVel(iPopindex, iDimindex) = -fVel(iPopindex, iDimindex)
        'frmSwarm.Print "Init. Pos & Vel ", fPos(iPopindex, iDimindex) _
            , fVel(iPopindex, iDimindex)         ' for diagnostic purpose
    Next iDimindex
Next iPopindex

' Main swarm loop here
For nIter = 1 To nMAXITER

    ' Update inertia weight; linear from fINITWT to 0.4
    fInerWt = ((fINITWT - 0.4) * (nMAXITER - nIter) / nMAXITER) + 0.4

  For iPopindex = 1 To iPOPSIZE     'MAIN main loop starts here
      'Setup dummy velocity vector for current population member
      For iDimindex = 1 To iDIMENSIONS
          fDumVel(iDimindex) = fVel(iPopindex, iDimindex)
      Next iDimindex

      iBetter(iPopindex) = 0              ' Set to 0 unless new Pbest achieved

      Select Case iFNCTNO                 ' returns fErrVal(iPopindex)
        Case 0
          Call evalf0(iPopindex)          ' evals f0 spherical function error
        Case 1
          Call evalf1(iPopindex)          ' evals f1 Rosenbrock function error
        Case 2
          Call evalf2(iPopindex)          ' evals f2 Rastrigrin function error
        Case 3
          Call evalf3(iPopindex)          ' evals f3 Griewank function error
        Case 5
          Call evalf5(iPopindex)          ' evals f5 He function error
        Case 6
          Call evalf6(iPopindex)          ' evals f6 Schaffer function error
      End Select


      If nIter = 1 Then
          fPbestVal(iPopindex) = fErrVal(iPopindex)
          iGbest = 1
      End If

      If fErrVal(iPopindex) < fPbestVal(iPopindex) Then   'If new Pbest
          fPbestVal(iPopindex) = fErrVal(iPopindex)

          For iDimindex = 1 To iDIMENSIONS    ' Reset Pbest location vector
              fBestPos(iPopindex, iDimindex) = fPos(iPopindex, iDimindex)
          Next iDimindex

          If fPbestVal(iPopindex) < fPbestVal(iGbest) Then
              ' color(iGbest) = DEFAULTCOLOR  need to dim these variables
              iGbest = iPopindex
              ' color(iGbest) = GBESTCOLOR
          End If

          If iUSEBETTER = 1 Then iBetter(iPopindex) = 1
      End If                                  ' End new Pbest loop
  Next iPopindex            'end MAIN main loop for gold gbest only


  For iPopindex = 1 To iPOPSIZE        'update velocity, position, graph position

      ' Does neighborhood calculation of iLbest
```

```
If iLOCAL > 0 Then
    For iHOODINDEX = 0 To iHOODSIZE
        iNeighbor(iHOODINDEX) = iPopindex - (iHOODSIZE / 2#) + iHOODINDEX
        'for iPopindex = 1,goes from 0 to 2 for iHOODSIZE of 2
        '                      from -1 to 3 for iHOODSIZE of 4
        ' Now wrap the ends of the array
        If iNeighbor(iHOODINDEX) < 1 Then iNeighbor(iHOODINDEX) = iPOPSIZE + _
          iNeighbor(iHOODINDEX)
        If iNeighbor(iHOODINDEX) > iPOPSIZE Then iNeighbor(iHOODINDEX) = _
          iNeighbor(iHOODINDEX) - iPOPSIZE
        'Start with iNeighbor(0) as iLbest and try to beat it
        If iHOODINDEX = 0 Then iLbest = iNeighbor(0)
        If fPbestVal(iNeighbor(iHOODINDEX)) < fPbestVal(iLbest) Then _
          iLbest = iNeighbor(iHOODINDEX)
    Next iHOODINDEX
End If

If iLOCAL = 0 Then iLbest = iGbest

' Update velocity vector for one particle Russ Reduced version
For iDimindex = 1 To iDIMENSIONS        'fInerWt below
    fVel(iPopindex, iDimindex) = (0.5 + (Rnd / 2)) * fVel(iPopindex, iDimindex) + _
     2# * Rnd * (fBestPos(iPopindex, iDimindex) - fPos(iPopindex, iDimindex)) + _
     2# * Rnd * (fBestPos(iLbest, iDimindex) - fPos(iPopindex, iDimindex))

    If fVel(iPopindex, iDimindex) > fMAXVEL Then
        fVel(iPopindex, iDimindex) = fMAXVEL
    ElseIf fVel(iPopindex, iDimindex) < -fMAXVEL Then
        fVel(iPopindex, iDimindex) = -fMAXVEL
    End If
Next iDimindex

'If it's going the right way, keep going
If iBetter(iPopindex) = 1 Then
    For iDimindex = 1 To iDIMENSIONS
        fVel(iPopindex, iDimindex) = fDumVel(iDimindex)
    Next iDimindex
End If

' Graphics Loop: Graphically plot updated positions

'Erase old position for two dimensions of one particle
iXcoord = Int((picSwarm1.ScaleWidth / 2#) * (1 + _
  10 * fPos(iPopindex, 1) / fMaxPos))
iYcoord = Int((picSwarm1.ScaleHeight / 2#) * (1 + _
  10 * fPos(iPopindex, 2) / fMaxPos))
picSwarm1.PSet (iXcoord, iYcoord), vbBlack

For iDimindex = 1 To iDIMENSIONS  'Define new positions for all dimensions
    fPos(iPopindex, iDimindex) = fPos(iPopindex, iDimindex) + _
      fVel(iPopindex, iDimindex)
Next iDimindex

'Graph new position for two dimensions of one particle
iXcoord = Int((picSwarm1.ScaleWidth / 2#) * (1 + _
  10 * fPos(iPopindex, 1) / fMaxPos))
iYcoord = Int((picSwarm1.ScaleHeight / 2#) * (1 + _
  10 * fPos(iPopindex, 2) / fMaxPos))
picSwarm1.PSet (iXcoord, iYcoord), vbRed

'If local neighborhood, graph iLbest
If iLOCAL > 0 Then
 iXcoord = Int((picSwarm1.ScaleWidth / 2#) * (1 + _
  10 * fPos(iLbest, 1) / fMaxPos))
 iYcoord = Int((picSwarm1.ScaleHeight / 2#) * (1 + _
  10 * fPos(iLbest, 2) / fMaxPos))
 picSwarm1.PSet (iXcoord, iYcoord), vbYellow
End If
```

```
    Next iPopindex                    'end velocity, position, graph loop

      'Graph 2 dimensions of iGbest
          iXcoord = Int((picSwarm1.ScaleWidth / 2#) * (1 + _
            10 * fPos(iGbest, 1) / fMaxPos))
          iYcoord = Int((picSwarm1.ScaleHeight / 2#) * (1 + _
            10 * fPos(iGbest, 2) / fMaxPos))
          picSwarm1.PSet (iXcoord, iYcoord), vbWhite

      'Terminate on sufficiently low error
      If (fPbestVal(iGbest) < fERRCUTOFF) Or nIter >= nMAXITER Then
          MsgBox "Iter: " & nIter & "  Err: " & fPbestVal(iGbest) ', vbYesNo
          Open sOutfile For Append As #2        'psoutfile.txt
          Print #2, "Iter: " & nIter, " Best val: " & fPbestVal(iGbest), Now
          Print #2, "Neighd. size (0=global): " & iLOCAL, " Fnctn# " & iFNCTNO, _
            " #Dims " & iDIMENSIONS
          For iDimindex = 1 To iDIMENSIONS
              Print #2, "Dim. " & iDimindex, "Pos. " & fPos(iGbest, iDimindex)
          Next iDimindex
          Close #2
          End                         'END PROGRAM
      End If

   Next nIter                          '   next nIter, end main loop
End Sub

   Sub evalf6(iPopindex)                ' evaluates f6 function error: fVal(iPopindex)
       Dim fNum As Double, fDenom As Double, fF6val As Double

       fNum = (Sin(Sqr((fPos(iPopindex, 1) * fPos(iPopindex, 1) + _
           fPos(iPopindex, 2) * fPos(iPopindex, 2))))) ^ 2 - 0.5
       fDenom = (1# + 0.001 * (fPos(iPopindex, 1) * fPos(iPopindex, 1) + _
           fPos(iPopindex, 2) * fPos(iPopindex, 2))) ^ 2
       fF6val = 0.5 - (fNum / fDenom)
       fErrVal(iPopindex) = 1# - fF6val
   End Sub

   Sub evalf0(iPopindex)                 'Evaluates spherical f0 function error
       fErrVal(iPopindex) = 0#

       For iDimindex = 1 To iDIMENSIONS
           fErrValDim = (fPos(iPopindex, iDimindex)) ^ 2
           fErrVal(iPopindex) = fErrVal(iPopindex) + fErrValDim
       Next iDimindex

   End Sub

   Sub evalf1(iPopindex)                  ' Evaluates Rosenbrock f1 function error
       fErrVal(iPopindex) = 0#

       For iDimindex = 1 To iDIMENSIONS - 1
           fErrValDim = 100# * (fPos(iPopindex, iDimindex + 1) - (fPos(iPopindex, iDimindex)) ^
 2) ^ 2 + (fPos(iPopindex, iDimindex) - 1) ^ 2
           fErrVal(iPopindex) = fErrVal(iPopindex) + fErrValDim
       Next iDimindex

   End Sub

   Sub evalf2(iPopindex)                  ' Evaluates Rastrigrin f2 function error
       fErrVal(iPopindex) = 0#

       For iDimindex = 1 To iDIMENSIONS
           fErrValDim = (fPos(iPopindex, iDimindex)) ^ 2 + 10# - 10# * Cos(2# * conPI * fPos(iP
opindex, iDimindex))
           fErrVal(iPopindex) = fErrVal(iPopindex) + fErrValDim
       Next iDimindex
   End Sub
```

```
    Sub evalf3(iPopindex)          ' Evaluates Griewank f3 function error
        Dim fFirstDim As Double, fSecondDim As Double
        Dim fFirstTot As Double, fSecondTot As Double
        fErrVal(iPopindex) = 0#
        fFirstTot = 0#
        fSecondTot = 1#

        For iDimindex = 1 To iDIMENSIONS
            fFirstDim = (fPos(iPopindex, iDimindex)) ^ 2
            fFirstTot = fFirstTot + fFirstDim
            fSecondDim = Cos(fPos(iPopindex, iDimindex) / Sqr(iDimindex))
            fSecondTot = fSecondTot * fSecondDim
        Next iDimindex

        fErrVal(iPopindex) = (0.00025 * fFirstTot) - fSecondTot + 1#
    End Sub

    Sub evalf5(iPopindex)              'Evaluates He f5 function error
        fErrVal(iPopindex) = (fPos(iPopindex, 1)) ^ 2 + 2# * (fPos(iPopindex, 2)) ^ 2 - _
        0.3 * Cos(3# * conPI * fPos(iPopindex, 1)) - 0.4 * Cos(4# * conPI * fPos(iPopindex, 2))
+ 0.7
    End Sub

Private Sub Form_Load()
frmSwarm.Show
End Sub
```

File: E:\Work\WRAIR\Data\actfile.txt 4/23/99, 12:34:28AM

Actigraph data file

308act.xls	309act.xls	310act.xls
330act.xls	331act.xls	332act.xls
333act.xls	334act.xls	335act.xls
337act.xls	349act.xls	350act.xls
351act.xls	369act.xls	370act.xls
371act.xls	372act.xls	

3*.xls 17

515act.xls	516act.xls	517act.xls
518act.xls	519act.xls	520act.xls
521act.xls	522act.xls	542act.xls
543act.xls	544act.xls	545act.xls
553act.xls	554act.xls	555act.xls
556act.xls		

5*.xls 16

711act.xls	712act.xls	713act.xls
714act.xls	723act.xls	724act.xls
725act.xls	726act.xls	738act.xls
739act.xls	740act.xls	741act.xls
757act.xls	758act.xls	759act.xls
760act.xls		

7*.xls 16

905act.xls	906act.xls	927act.xls
928act.xls	929act.xls	946act.xls
947act.xls	948act.xls	961act.xls
962act.xls	963act.xls	964act.xls
965act.xls	966act.xls	967act.xls
968act.xls		

9*.xls 16

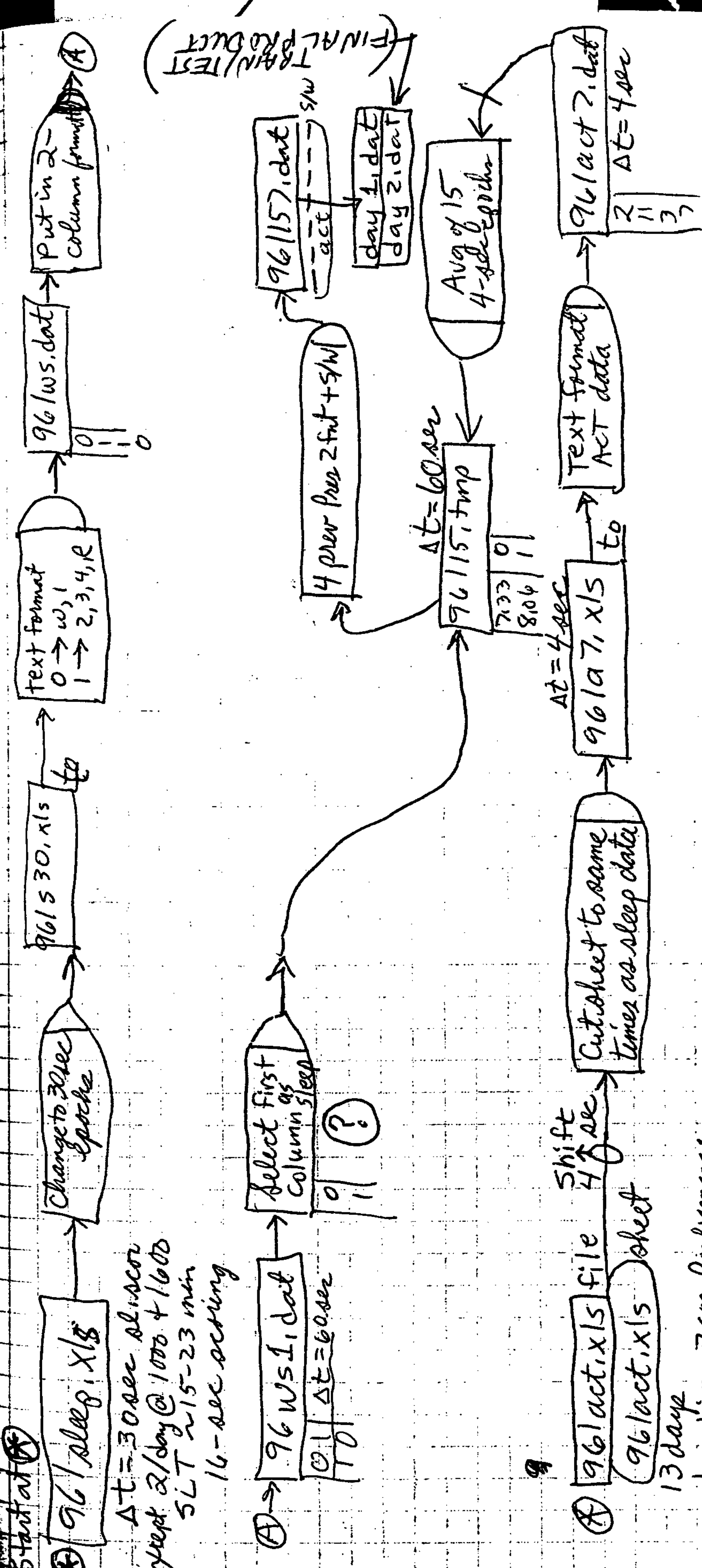
total 65 files

PSG data file

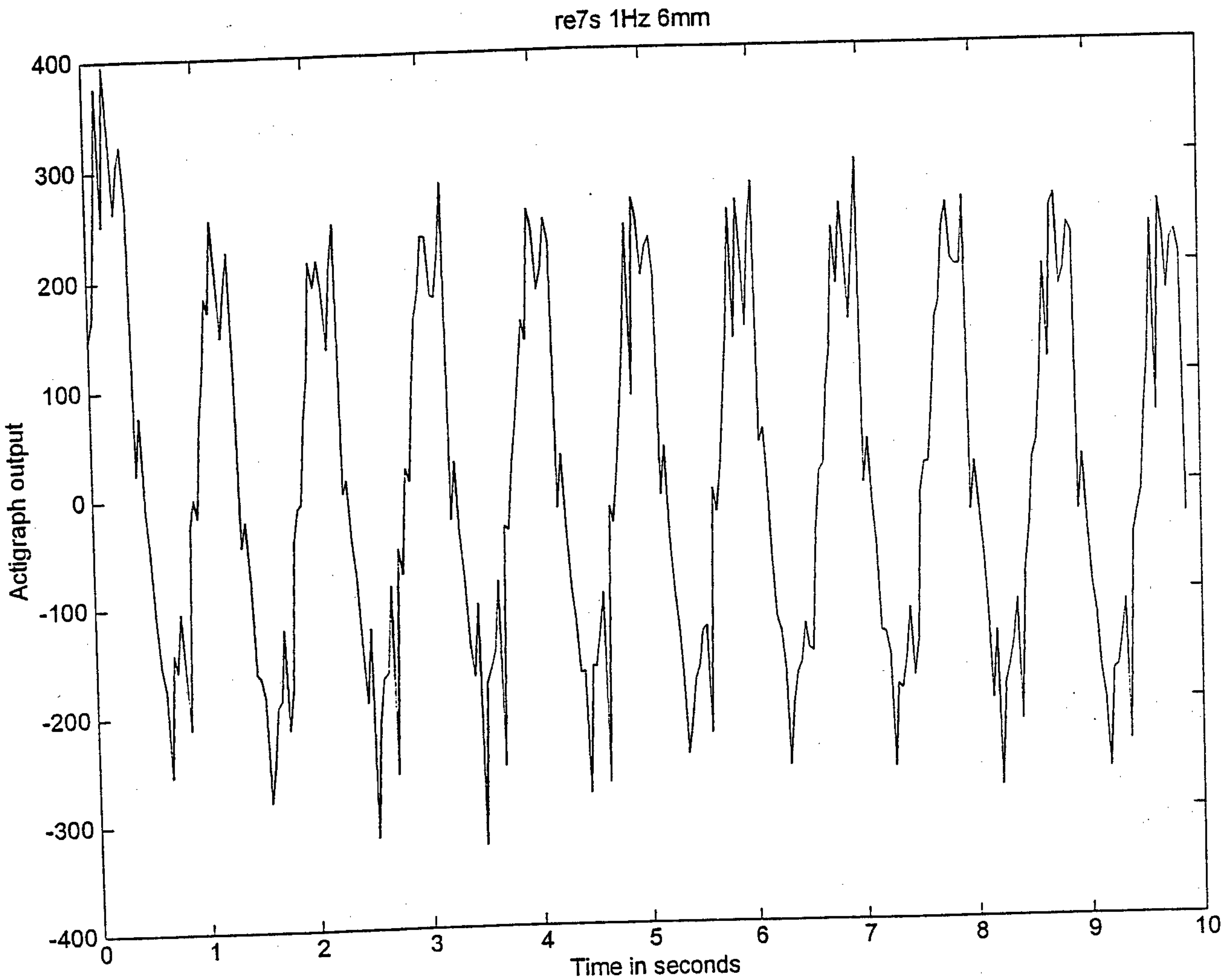
372sleep.xls
555sleep.xls
711sleep.xls
961sleep.xls

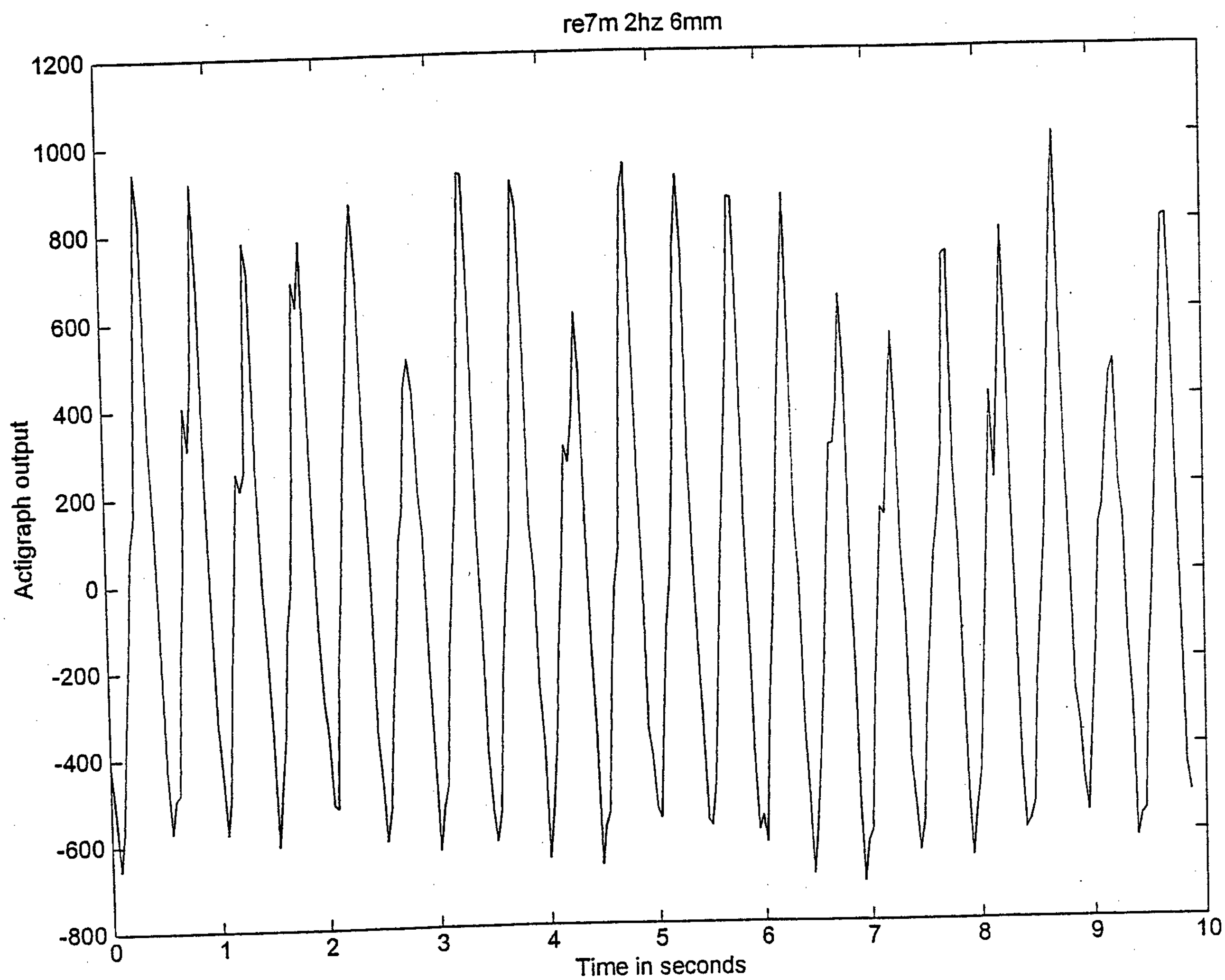
total 4 files

APPENDIX D

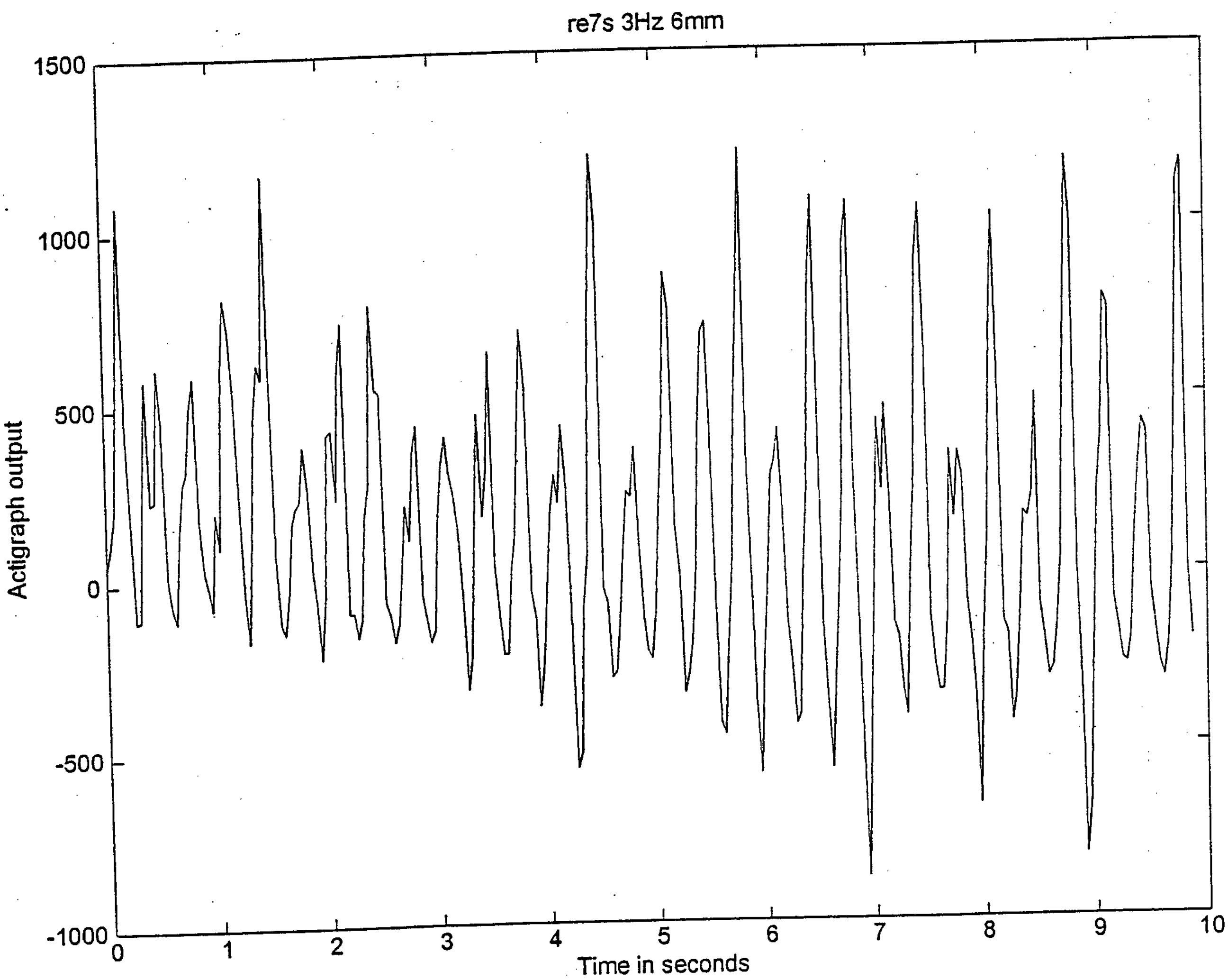


Start at ✱
✱ 961sleep.xls
Δt = 30sec sl.scor
except 2/day @ 1000 + 1600
SLT ~15-23 min
16-sec scoring
Change to 30sec epochs
961s30.xls
to
text format
0 → w, 1
1 → 2, 3, 4, R
961ws.dat
0
1
1
0
Put in 2-column format
A
A → 96ws1.dat
0 1
1 0
Δt = 60sec
Select first column as sleep
0
1
?
96115.tmp
Δt = 60sec
7:33 0
8:06 1
4 prev pres 2fut + S/W
96157.dat
act
S/W
day 1.dat
day 2.dat
TRAIN/TEST
FINAL PRODUCT
Avg of 15 4-sec epochs
✱ 961act.xls file
961act.xls sheet
13 days
day time zcm Performance
empty
Shift 4 sec
Cut sheet to same times as sleep data
Δt = 4 sec
961a7.xls
to
Text format ACT data
961act7.dat
Δt = 4sec
2
11
3
7


re7s 1Hz 6mm
Actigraph output
Time in seconds
400
300
200
100
0
-100
-200
-300
-400
0
1
2
3
4
5
6
7
8
9
10



re7m 2hz 6mm
1200
1000
800
600
400
200
0
-200
-400
-600
-800
Actigraph output
0
1
2
3
4
5
6
7
8
9
10
Time in seconds



re7s 3Hz 6mm
Actigraph output
Time in seconds
1500
1000
500
0
-500
-1000
0
1
2
3
4
5
6
7
8
9
10